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He was able to induce premature fading by applying most various substances to the stigma: besides their own living pollen, volcanic river-sand, spittle, dead pollen and pollen extract, dead and leached pollen of the same species or of other genera or even of other and remote groups, and extract of gynostemium tissues induced it, and apparently also 5 per cent. saccharose. He was not able to determine what the chemical agent or agents were in these reactions. Wounding the stigma or the tissue at the apex of the gynostemium also caused premature fading. Closure of the stigma and swelling of the gynostemium could be effected by bestrewing the stigma with living or dead pollen of orchids (any genus) or even of Hibiscus, and with the alcoholic extract of pollen. On the contrary, dead pollen and pollen extract had no effect or the very slightest in inducing swelling of the ovary, which occurred only when living pollen germinated on the stigma and its tubes grew into the ovary. The greening of the perianth (peculiar to certain species) appears only when the ovary has previously begun to swell and to turn green.

FITTING considers fading as the end process of floral development, simply released by the pollen stimulus or others earlier than it is autonomously. The stimulus, however, does not merely hasten development; it diverts its course, for a perianth half open and quite incompletely developed may be made to fade in twelve to twenty-four hours by a stimulus which proceeds from the distant stigma. This also offers a new example of the separation of perceptive and reactive regions. The closure of the stigma, etc., appears to be strictly a case of chemomorphosis, but the agent does not produce any effect on the ovary, whose growth and formation of ovules, and so the consequent greening of the perianth, depend on the penetration of the pollen tube; but whether the stimulus is mechanical or chemical does not appear.

The prompt fading of the flowers, possible after an insect bite on the stigma or after stimulation by foreign pollen, and the small crop of fruit on these tropical orchids, awaken doubts in FITTING's mind as to the validity of the teleological interpretation of the elaborate mechanisms which are believed to secure cross-pollination. Perhaps they were effective in a past age when insect life was richer, he adds by way of apology for his temerity in suggesting such heresy. He will find this heresy not unwelcome, we imagine, in this country, where ecologists are questioning whether there is even adequate proof that cross-pollination is advantageous.—C. R. B.

Cytology of *Oenothera*.—GEERTS²³ published an account of embryo-sac development and chromosome reduction in *Oenothera*. A row of four megaspores is formed, with typical reduction phenomena, the megaspore nearest the micropyle forming the embryo sac. Its nucleus divides only twice. Both

²³ GEERTS, J. M., Beiträge zur Kenntnis der cytologischen Entwicklung von *Oenothera Lamarckiana*. Ber. Deutsch. Bot. Gesells. 26a:608–614. 1908.

———, Beiträge zur Kenntnis der Cytologie und der partiellen Sterilität von *Oenothera Lamarckiana*. Separate (source unknown). pp. 116. pls. 5–22. 1909.

nuclei resulting from the first division remain in the upper portion of the sac. One of these divides to form the two synergids, and the other forms the egg and polar nucleus. There are therefore no antipodals and only one polar nucleus. In fertilization one male nucleus unites with the egg; the other unites with the polar nucleus to form the endosperm.

The account of reduction phenomena confirms, in all the main points, the previous accounts of GATES.²⁴ There is no fusion of parallel threads in synapsis. The spirem later breaks into the vegetative number of chromosomes, which afterward become paired. The first mitosis separates whole chromosomes, and the second separates the longitudinal halves of these. Certain critical stages during the period between synizesis and diakinesis, which prove that the chromosomes are formed by the segmentation of a single spirem thread, are not represented; but these stages are the most difficult to obtain, probably because they are passed through quickly. It seems now pretty evident that there are two general methods of reduction in plants, as in animals, one involving a telosynapsis, the other a parasynapsis or side-by-side pairing of chromosomes.

The question of sterility is also examined, with interesting results. In *Oenothera Lamarckiana* 50 per cent. of the ovules are found to degenerate, and about 50 per cent. of the pollen grains—two from each tetrad of spores. A large number of other Onagraceae were examined, nearly all of which were found to exhibit more or less sterility. GEERTS concludes that the sterility of *O. Lamarckiana* cannot be explained as the result of hybridization, cultivation, or lack of nutrition or space, but that it has been inherited from a remote ancestor, probably from the ancestor of the whole sub-family. He thinks that since this sterility is heritable it must have originated by a mutation, or rather two mutations, one on the pollen side and one on the megaspore side, since they are often sterile in different degrees in the same species!

So far from explaining anything, it seems to the reviewer that this muddies the pool and is much worse than a flat confession of ignorance as to the cause. It will be unfortunate if botanists acquire the habit of ascribing the origin of complex conditions, such as sterility, to a sudden "mutation" in some ancestor. There is no evidence to show that the sterility has not been gradually acquired, and for that matter independently acquired, in the different species. To call it a mutation helps to explain neither its origin nor its cause.—R. R. GATES.

Seedlings of conifers.—HILL and FRAINE²⁵ have published a second paper on the seedlings of gymnosperms, the thesis being that polycotyledony is attained by the splitting of preexisting members, which were probably two in number. In the present investigation seedlings of *Tsuga*, *Abies*, *Picea*, *Cedrus*, *Pinus*, *Larix*, *Pseudolarix*, and *Araucaria* were studied. The general result shows that

²⁴ GATES, R. R., A study of reduction in *Oenothera rubrinervis*. BOT. GAZETTE 46:1-34. pls. 1-3. 1908.

²⁵ HILL, T. G., AND DE FRAINE, E., On the seedling structure of gymnosperms. Annals of Botany 23:189-227. pl. 15. figs. 11. 1909.